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The importance of procalcitonin in the diagnosis and prognosis of patients with dyspnea in the emergency department

Is procalcitonin gold standart in pneumonia?

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Abstract
Aim: Dyspnea is a common problem in emergency services worldwide. Bacterial pneumonia is a common etiology in patients with acute dyspnea causing morbidity and mortality. Early initiation of appropriate antibiotic therapy reduces mortality. However, it is difficult to diagnose pneumonia with symptoms similar to acute heart failure and acute exacerbation of chronic obstructive pulmonary disease, and without definitive diagnostic testing. For this, it is thought that the use of a biomarker that can diagnose pneumonia at the time of admission to the hospital would be clinically useful.
Material and Methods: Patients who came to the emergency department with shortness of breath were analyzed retrospectively. Three hundred patients were examined. Serum procalcitonin values of patients diagnosed with pneumonia by chest radiography or thorax CT were compared with other patients. Patients discharged from the emergency department or hospitalized were classified as a good clinical outcome group, patients who were intubated, in need of intensive care, or who died were classified as a poor clinical outcome group, and procalcitonin values were compared. The data were evaluated using the SPSS Statistics Standard statistical package program. A $p < 0.001$ value was considered statistically significant.
Results: In patients presenting with dyspnea, pneumonia (150), COPD exacerbation (30), lower respiratory tract infection (LRTI) (18), acute coronary syndrome (ACS) (27), and acute heart failure (AHF) (76) were diagnosed. The PCT values of the patients diagnosed with pneumonia were significantly higher than the other groups ($p < 0.001$). In terms of white blood cell (WBC) values, there was no significant difference between pneumonia patients and other patients. When the neutrophil-lymphocyte ratio (NLR) was examined, it was found to be significantly higher in pneumonia patients ($p < 0.001$). When we examined the prognosis of pneumonia patients, the PCT values of the patients with a poor prognosis were found to be significantly higher ($p < 0.001$).
Discussion: We have seen that PCT has an important role in the diagnosis and prognosis of pneumonia in patients admitted to the emergency department with shortness of breath.

Keywords
Procalcitonin; Dyspnea; Pneumonia

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Introduction

One of the most common admissions to emergency services in the world is shortness of breath [1]. Bacterial pneumonia is an important cause of morbidity and mortality in patients with acute dyspnea [2]. Early initiation of appropriate antibiotic treatment reduces mortality [3,4]. However, the diagnosis of pneumonia can be difficult because it coincides with the symptoms of other causes of dyspnea, such as acute heart failure and acute exacerbation of chronic obstructive pulmonary disease, and there is no definitive diagnostic test [5]. Besides, the fact that many patients presenting with dyspnea have more than one disease at the same time makes their diagnosis and treatment difficult.

When biomarkers are evaluated in combination with clinical risk scores, they are being used more to identify specific patients at risk, to evaluate the severity and prognosis of the disease, and more recently to guide antibiotic treatment [5]. Procalcitonin (PCT) is normally a calcitonin prohormone and is produced by thyroid C cells. Serum PCT levels are too low to be detected in healthy individuals, its production increases in bacterial infections, and its production by cytokines is reduced in viral infections [6,7]. PCT has received much attention as a good biomarker of bacterial infection, as it has good specificity for severe bacterial infections in patients with clinically suspected sepsis, and can distinguish infections from general inflammation [8,9]. Therefore, in order to diagnose or exclude pneumonia correctly, potential values of PCT have been examined in many recent studies [10,11]. However, there are not many studies examining the use of PCT in patients with acute shortness of breath. Therefore, in this study, we aimed to examine the diagnostic and prognostic results of PCT in patients presenting with acute dyspnea.

Material and Methods

This study was approved by the decision of Izmir Katip Çelebi University non-invasive clinical studies ethics committee dated 25.04.2019 and numbered 185.

In our study, the files of patients who applied to the 2nd step Emergency service with complaints of dyspnea between January 2018 and March 2019 were retrospectively scanned. Patients under 18 years of age and whose results could not be seen through the hospital information system were not included in the study. Three hundred patients were included in the study.

Patients due to acute respiratory reasons

The diagnosis of decompensated heart failure (CHFF) and acute coronary syndrome (ACS) was made due to pneumonia, lower respiratory tract infection (LRTI), COPD attack and acute cardiac causes.

Blood values and procalcitonin values of the patients were recorded. The normal range of procalcitonin measured in our hospital was found to be 0-0.05 ng / ml. We compared the serum procalcitonin values of patients diagnosed with pneumonia by chest X-ray or thorax CT with those of other patients. Patients discharged from the emergency department or hospitalized were classified as a good clinical outcome group, patients who were intubated, required intensive care, or died, were classified as a poor clinical outcome group and procalcitonin values were compared. We also compared PCT with white blood cell (WBC) and neutrophil-to-lymphocyte ratios (NLR).

The data were evaluated using IBM SPSS Statistics Standard Concurrent User V 25 (IBM Corp., Armonk, New York, USA) statistical package program. Descriptive statistics were given as the number of units (n), percentage (%), median (M), 25th percentile (Q1), and 75th percentile (Q3). The normal distribution of the data of numerical variables was evaluated using the Shapiro Wilk normality test and Q-Q graphics. The Kruskal-Wallis analysis was used to compare groups for variables that did not show normal distribution. If a difference was found as a result of the Kruskal-Wallis analysis, multiple comparisons were made using the Dunn-Bonferroni test. Comparisons of two groups were made using the Mann-Whitney U test for variables that did not show normal distribution. P <0.05 value was considered statistically significant.

Results

Three hundred patients were included in the study. Thirty patients were diagnosed with ACS, 76 with DCHF, 18 with LRTI, 26 with COPD attack, and 150 with pneumonia. PCT values were compared between these groups. There was a statistically significant difference in PCT between the groups of patients with pneumonia and all other groups (p <0.001) (Table 1).

In addition, we compared the PCT values of the patients with their WBC and NRL values (Table 2). There was a significant difference between the PCT of pneumonia patients and the PCT of all other patients. When we compare the WBC and NRL values, we found a significant difference between patients with pneumonia and patients with ACS, DCHF and COPD attacks.

Classifying the patients with pneumonia as good and bad outcomes according to their clinical outcomes, PCT; We compared the WBC, NLR and PCT values (Table 3). We found statistically significant difference in the NEU and LEU variables. We found that PCT would be more useful in predicting worse outcome in patients with pneumonia.

Table 1. Comparison of PCT between groups

	PCT (ng/mL)
ACS	0,08 (0,01-0,16)
LTRI	0,15 (0,09-0,53)
DKHF	0,09 (0,03-0,16)
COPD ATTACK	0,22 (0,06-0,39)
PNEUMONİA	2,30 (0,38-7,52)*

* p <0.001 When compared with other groups with pneumonia.

Table 2. Comparison of PCT - WBC - NRL values between groups

	Groups					p
	ACS[a] M (Q_1-Q_3)	LTRI[b] M (Q_1-Q_3)	DCHF[c] M (Q_1-Q_3)	COPD_ATTACK[d] M (Q_1-Q_3)	Pneumonia[e] M (Q_1-Q_3)	
PCT	0,08 (0,01-0,16)[e]	0,15 (0,09-0,53)[e]	0,09 (0,03-0,16)[e]	0,22 (0,06-0,39)[e]	2,30 (0,38-7,52)[a,b,c,d]	<0,001
WBC	7,20 (5,60-8)[b,e]	13 (10,90-16,50)[a,c]	8,60 (5,60-10,80)[b,e]	10,50 (7,30-12,08)[e]	15 (12-17,93)[a,c,d]	<0,001
NRL	2,5 (1,6-3,4)[b,e]	7,1 (4,9-9,8)[a,c]	3,4 (2,6-5,6)[b,e]	5,4 (4-6,7)[e]	12.075 (8-15,9) [a,c,d]	<0,001

The superscripts [a, b, c, d] and [e] in the table show the differences between groups.

Table 3. Comparison of PCT - WBC - NRL values according to clinical outcomes of patients with pneumonia

	GROUPS		p
	GOOD M (Q_1-Q_3)	BAD M (Q_1-Q_3)	
PCT	0,92 (0,18-2,59)	8,37 (3,35-27,67)	<0,001
WBC	14,60 (12-17)	16,10 (11- 17,93)	0,085
NLR	8,5 (7,4-12,5)	13 (11,5-15,9)	<0,001

Discussion

Over the years, numerous studies have been conducted investigating the clinical usefulness of biomarkers in the diagnosis, prognosis, staging and monitoring of sepsis [12,13]. Thus, many studies have focused on the use of a single biomarker, but interest has increased in the search for new sepsis biomarkers, especially using high-throughput methods for screening patient samples [14]. In this study, we investigated the importance of procalcitonin in diagnosis and prognosis in patients who came to the emergency department with shortness of breath.

We found that PCT provides a good distinction between patients with acute dyspnea in the emergency room for diagnosing and excluding pneumonia. More importantly, we have found that PCT concentrations provide an accurate diagnosis of pneumonia, especially in patients with comorbidities such as heart failure.

PCT, a precursor of calcitonin, has received widespread attention as a biomarker of bacterial infection, as it has good specificity for severe bacterial infections in patients with clinically suspected sepsis and can distinguish infections from general inflammation [15]. Serum PCT levels are found to be low under normal conditions. PCT does not increase significantly in immunological diseases and viral infections, besides it is accepted as specific for bacterial infections [16]. Based on recent studies, the literature has shown that PCT has sometimes conflicting benefits in the diagnosis and management of infectious syndromes, including pneumonia [17,19].

There are markers that we traditionally used to evaluate inflammation in the clinic, such as white blood cell (WBC), C-reactive protein (CRP) levels, and neutrophil-lymphocyte ratio (NLR) [20]. Studies have shown that NLR is a useful measure in determining systemic inflammation [21].

In our study, when we examined patients who came to the emergency room with shortness of breath, we showed that PCT was significantly better than WBC and NLR in diagnosing pneumonia. This provides early initiation of pneumonia treatment and increases survival.

Conclusion

Clinically, biomarkers are important for both diagnostic and prognostic efficiency. PCT also has an important potential in optimizing the correct diagnosis for pneumonia and predicting prognosis. Our results also support the diagnostic and prognostic value of PCT in patients with acute dyspnea, contributing significantly to clinical variables and other biomarkers for these applications.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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